REMARKS

Claims 1-3, 5-16, and 18-32 are pending in this application, of which claims 1-3, 5-14, and 21-24 have been withdrawn from consideration. Claims 15, 16, 18-20, and 25-28 were rejected. Claims 4, 9, 17, 18, 20, 26 and 28 have been canceled. Claims 29-32 have been newly added. Reconsideration of the rejections in view of these amendments and the following remarks is respectfully requested.

Objection to Claims

Claims 15 and 25 were objected to because of informalities.

Accordingly, these claims have been amended to overcome this objection.

Rejections under 35 USC §112, First Paragraph

Claim 28 was rejected under 35 USC §112, first paragraph, as allegedly failing to comply with the written description requirement.

Claim 28 has been canceled. Therefore, the rejection to the claim has become moot.

Rejections under 35 USC §102(b)

Claims 15 and 16 were rejected under 35 USC §102(b) as being anticipated by Lee (U.S. Patent No. 6,077,450).

Applicant respectfully traverses this rejection.

Claim 15 has been amended to incorporate the contents of claims 18, 20, and 26. Thus, claim 15 has been amended to recite "A method of manufacturing a semiconductor device, comprising the steps of: (a) forming a rare metal layer above a semiconductor substrate formed with semiconductor elements; (b) forming a metal nitride layer without using hydrogen-containing gas; (c) forming an insulating mask layer on the metal nitride layer; (d) patterning the insulating mask layer by using a resist pattern; (e) removing the resist pattern used in said step (d); (f) patterning the metal nitride layer by using the patterned insulating mask layer; (g) patterning the rare metal layer by using the patterned insulating mask layer and the patterned metal nitride layer; and (h) forming an insulating film over the semiconductor substrate to cover the patterned insulating mask layer, the insulating film being a TEOS based SiO layer, wherein said step (d) is terminated before the rare metal layer is exposed."

Responding to Applicant's previous response, the Examiner alleged that "Lee teaches terminating patterning the insulating mask before the rare metal layer is exposed and patterning the metal nitride and the rare metal layer by using the patterned insulating mask layer (the resist pattern is removed before patterning the metal nitride layer because only the patterned insulating mask layer is employed as a mask) (Fig. 3b-3d, col. 3, lines 10-35)."

Lee discloses in Figs. 3a-3e, forming a rare metal layer 23, forming a metal nitride layer 24 on the rare metal layer, possibly forming a non-conducting layer, then forming a photoresist pattern 25 as shown in Fig. 3b, patterning the non-conductive layer using the resist pattern, then patterning the metal nitride layer using the patterned non-conductive layer, and patterning the rare metal layer using the patterned mask layer as shown in Figs. 3c and 3d.

Lee, however, does not teach or suggest that the metal nitride layer 24 should be formed without using hydrogen-containing gas, and forming an insulating film, i.e., a TEOS based SiO layer, over the semiconductor substrate to cover the patterned insulating mask layer. Silicon oxide is usually formed by using silane and oxygen-containing gas. If silane is used, much hydrogen will be generated. When TEOS is used, generation of hydrogen can be suppressed.

Thus, Lee does not teach or suggest, among other things, "(b) forming a metal nitride layer without using hydrogen-containing gas; . . . and (h) forming an insulating film over the semiconductor substrate to cover the patterned insulating mask layer, the insulating film being a TEOS based SiO layer."

The rare metal layer is used commonly for electrodes of capacitors using oxide dielectric layer. For such use, hydrogen can affect the characteristics of the capacitor when diffused into the oxide dielectric layer. TEOS has a function of blocking hydrogen, and generates less hydrogen when formed. The metal nitride layer formed without using hydrogen-containing gas avoids generation of hydrogen.

For at least these reasons, claim 15 patentably distinguishes over Lee. Claim 16, depending from claim 15, also patentably distinguishes over Lee for at least the same reasons.

Thus, the 35 USC §102(b) rejection should be withdrawn.

Rejections under 35 USC §103(a)

Claims 18-20 and 26 are rejected under 35 USC §103(a) as being obvious over Lee in view of Joo (U.S. Patent No. 6,342,425).

Claims 18, 20 and 26 have been canceled. Thus, the rejection of these claims has become moot.

Claim 19, depending from claim 15, patentably distinguishes over Lee for at least the same reasons discussed above. Joo has been cited for allegedly disclosing using hydrogen-containing gas to form the metal nitride layer, forming a dielectric film on the patterned lower electrode and forming a silicon oxide film by TEOS based CVD, and annealing the semiconductor substrate in hydrogen containing gas. Such disclosures, however, do not remedy the deficiencies of Lee discussed above.

For at least these reasons, claim 19 patentably distinguishes over Lee and Joo.

Claims 25 and 27 were rejected under 35 USC §103(a) as being obvious over Lee in view of Joo and Hasegawa et al (U.S. Patent No. 6,452,274).

Applicant respectfully traverses these rejections.

Claim 25 has been amended to incorporate the content that the insulating film is a TEOS based SiO layer. Thus, claim 25 has been amended to "A method of manufacturing a semiconductor device, comprising the steps of: (a) forming a rare metal layer above a semiconductor substrate formed with semiconductor elements; (b) forming an insulating mask layer on the rare metal layer; (c) patterning the insulating mask layer by using a resist pattern; (d) patterning the rare metal layer by using the patterned insulating mask layer; and (f) forming an insulating film over the semiconductor substrate, the insulating film covering the patterned

insulating mask layer, wherein said insulating mask layer is a TaO layer and said insulating film is a TEOS based SiO layer."

Lee describes the process, at the portions referred to by the Examiner, as follows:

> Referring initially to FIG. 3A, ... A 6000 Angstrom thick titanium nitride layer 24 is formed on the platinum layer 23. Instead of a titanium nitride layer 24, a titanium layer or an aluminum layer or an a aluminum alloy layer such as, Al/AlSi, or AlSiCu may be deposited. A non conductive layer such as a silicon oxide layer, a silicon nitride layer, or a photoresist film may be additionally deposited on the titanium nitride layer 24.
>
> Referring to FIG. 3B, a 7500 Angstrom thick photoresist film 25 is coated on the titanium nitride layer 24 and patterned selectively by using a KrF stepper having 0.43 μm pitch (0.21 space).
>
> Referring to FIG. 3C, C12 +HBr is injected with the patterned photoresist film 25 serving as a mask to etch the titanium nitride layer 24. Then the remaining photoresist film is removed. **In case that a non-conductive layer is deposited on the titanium nitride layer 24, the non conductive layer is etched with the patterned photoresist film serving as a mask and the titanium nitride layer 24 is then etched with the etched nonconductive layer serving as a mask.**
>
> Referring to FIG. 3D, when the titanium nitride layer 24 serves as a mask, the platinum layer 23 is etched in 25 HBr+25 O2 under a pressure of 5 mTorr for 200 seconds by imposing an energy of 300-600 w (13.56 MHz) on a high frequency provider and an energy of 0-100 w (450 kHz) on a low frequency provider.

In Lee, titanium nitride layer 24, which is conductive, is formed on the platinum layer 23, and when the non-conductive layer is formed, it is formed on the titanium nitride layer 24. Thus, Lee does not teach or suggest, among other things, "(b) forming an insulating mask layer on the rare metal layer," as recited in claim 25.

Joo has been cited for allegedly disclosing using hydrogen-containing gas to form the metal nitride layer, forming a dielectric film on the patterned lower electrode and forming a

silicon oxide film by TEOS based CVD, and annealing the semiconductor substrate in hydrogen containing gas. Such disclosures, however, do not remedy the deficiencies of Lee.

Also, the Examiner alleged that although Lee does not specifically teach a TaO layer, Hasegawa et al shows TaO being used instead of silicon oxide as a mask. Hasegawa et al, however, teaches TaO as a mask to be formed on a low dielectric layer, but does not teach the use of TaO layer as a mask for patterning a rare metal layer.

For at least these reasons, claim 25 patentably distinguishes over Lee and Joo. Claim 27, depending from claim 25, also patentably distinguishes over Lee and Joo for at least the same reasons.

Thus, the 35 USC §103(a) rejection should be withdrawn.

New Claims

Claims 29-32 have been added. The subject matter recited in these claims is supported by the laminated insulating mask layer as described on page 16, line 17 to page 17, line 1 in the specification.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact the undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees that may be due with respect to this paper to Deposit Account No. 50-2866.

Respectfully Submitted,

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